

STYLISTIC DESIGN ENGINEERING (SDE) FOR AN INNOVATIVE GREEN VEHICLE FOLLOWING QFD AND TRIZ APPLICATIONS

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ABSTRACT

With this article, we intend to set the first strategic phase of the product development process, that is to say the one related to the conceptual project. In particular, this work refers to the installation of the project of an innovative, green, sustainable means of transport based on renewable energy, to move to the center of medium and large cities. The discussion presented presents a series of cutting-edge methods, in series of logical use, in order to make both strategic and technical decisions. Among the inputs of the methods, we will have an analysis of customer needs, competitive analysis, a series of technological objectives (or performances) as a result of the work in progress. In particular, we will first use the quality distribution method (QFD), then the method of analyzing competition through Benchmarking to identify the quantitative requirements that will give us the opportunity to create an innovative product, enhanced by a Top-Flop analysis to determine the number of requirements of the best product on the market, which will be the limit to be overcome to embody innovation in a new project. As for the QFD, the input values are the customer's requirements, obtained with the "Six questions" method; then applying an interrelationship of the QFD matrix, the outputs of the method described above were obtained, representing the classification of all the various urban transports, classified according to user preferences.

The application of the competition-oriented method of competition analysis through the use of Benchmarking is applied after the QFD.

The inputs are the quantitative specifications, that is the performance, of all the hoverboard models of all the brands on the market. The output, however, is a comparison graph that contains all the performance values for each model. Other inputs will be table data, other outputs, values (or ranges of values) for each performance, so as to obtain a technical specification with quantitative objectives to obtain an innovative product.

KEYWORDS: Design Engineering, TRIZ, Quality Distribution Method, 3D & Hoverboard

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1. INTRODUCTION

Why Apply the Innovation of Renewable Energy to the Transport of New Cities?

Our way of life is closely related, among other things, to the way we travel to realize our activities (work, leisure, study, etc.). We think, we are correct when we use the car, maybe even when there is no real need. The car, which we greatly appreciate, has in fact some positive aspects (especially autonomy), but, above all in urban journeys, are often overcome by other important and negative elements suffered personally by the driver

(time lost in the queue, difficulties and costs of parking, etc.).

However, there are also many negative effects that the rest of citizens can suffer, those who may move without a car. For example, the problems generated by traffic, and these people suffer from the so-called "external costs", i.e. those negative effects generated by those, who use the road transport system but who are experienced by all other citizens, even by those who do not own a car.

Today, traffic is an integral part of urban life that influences our habits, takes time away from social relationships and emotions, causes stress, and is harmful to health. Every day, many people die in road accidents (including many pedestrians) and many others are injured. The social cost of road accidents is around 24 billion euros. The pollution deriving from the machine collects thousands of victims every year. In almost all major cities, the PM10 limits imposed by the Air Quality Directive are not met.

In addition to social and environmental damage, we must also remember the economic costs associated with the ownership and maintenance of private vehicles: on average, each house spends about 5000 euros per year in Europe.

Furthermore, the economic value of the time lost in traffic is estimated at around EUR billions at the national level.

The alternatives to cars are often unattractive. The mobility of public transport and the bicycle does not always have the attention that administrators deserve, not only for lack of resources, but very often the appropriate specialist skills. In the absence of viable alternatives, the car remains the preferred medium for many Europeans, although many, in equal travel times, would be willing to use public transport. But today the share of travel by public transport is lower than desired, mainly due to the lack of driving comfort, coincidences and infrequent connections.

As for the bike, it could be a real means of transport in the city for short distances, but it fails to settle mainly due to the lack of road safety conditions, with the exception of countries such as the Netherlands and Denmark.

All of the above described makes us understand the need to develop an innovative means of transport that overcomes the problems related to traffic, pollution, lack of comfort and the possibility of reducing transport times. Basically it is necessary to understand which means of transport will be those of the future for future mobility.

Therefore, this work will develop a decision-making process based on QFD, Bench Marking and 6W, in order to identify the guidelines for designing the means of transport of the ideal city.

2. QFD (QUALITY FUNCTION DEPLOYMENT)

An innovative method to manage the flow of information that normally accompanies the design phase of a product is known as Quality Function Deployment (QFD). If you want to transform the customer's wishes, the QFD method is suitable for this purpose, intercepting the real needs of users in the design requirements, suitable for all industrial needs, from applied research to product development, creation and production to distribution, from marketing to sales and related support services [1,2].

This method has been developed to take into account the technical requirements for customizing a product during the phases of product development and innovative production. QFD helps designers to bring forward those wishes, expressed and unexpressed by customers or potential users, translate them into actions and projects, and then focus on the various business functions, towards a common goal. The method can be synthesized in this way [3,4,5],

1. Clients' requirements
2. Clarifying quality system
3. Positive quality to add value
4. Quality for customers' satisfaction
5. Strategy for competitive game

The QFD begins with an explanation of the activity that can be summarized with the following scheme)

- A. Analysis of market environment
- B. Analysis of competitors
- C. The six questions to describe the products
- D. The evaluation matrixes

2.1. The Six Questions

After clarifying the activity, with which the technical requirements are defined, it is possible to start designing the product. The analysis of the environment and the six questions are both part of the clarification of the activities. In particular, the analysis of the environment means understanding the positioning of the new product and its innovative requirements; The analysis of competitors' products means understanding competitors similar products and how to improve them; thus, six questions immediately help to extrapolate the requirements that must be embodied by the object to be designed. They are (Table 1),

Table 1: Six Questions

QFD Questions	Embodiment
Who	Who uses our product?
What	What is the use of the product?
Where	Where is it used?
When	When is it used?
Why	Why is it used?
How	How is it used?

Applying the six questions to the case of innovative city transport, the research group that developed this document was able to provide the following answers, in order to find the requirements to be analyzed through the interrelation matrix.

1) **WHO:** who uses innovative urban transport

Innovative City Transportation Means - (ICTM)? ICTM is used by people to: go to work; move in the city center and in traffic; avoid as many barriers as possible; go shopping.

Requirements obtained after the discussion:

Immediate Use, Agility, Mobility, Destrezza, Access to the Limited Traffic Area, Ductility of Use, Accessibility to Closed Spaces, Accessibility to Pedestrian Areas.

2) **WHAT:** what is the use of ICTM? ICTM is used to: transport people; go faster than walk; move in the city

center; move in confined spaces; used in free time; go to work.

Requirements obtained after the discussion:

Transportation Capacity for Driver and Other People, Higher Speed to Pedesis, Dynamicity, Flexibility, Fun, Availability.

3) WHERE: where is the ICTM used? It is used in the city center; in closed spaces; in traffic; in the pedestrian areas.

Requirements obtained after the discussion: Agility, Mobility, Access to the Limited Traffic Area, Flexibility of Use, Accessibility to Closed Areas, Accessibility to Pedestrian Areas.

4) WHEN: when is ICTM used? It is used: in the morning to go to work; during the leisure weekend; to go shopping; as an alternative to going on foot.

Requirements obtained after the discussion: Reliability of Use, Accessibility, Flexibility of Use, Speed.

5) WHY: why is ICTM used? It is used for: to go faster than on foot; avoid making effort; to get there first; have fun; not to pollute.

Requirements obtained after the discussion: Comfort, Speed, Immediate Use, Fun, Ecology, Duration of Use, Autonomy, Dynamic.

6) HOW: how is ICTM used? It can be used: as a means of transport; as a service tool; safely (it can hardly be stolen, being transportable); in a flexible way (it can be used to access closed spaces, such as supermarkets and discount stores); to be able to carry it and take it away.

Requirements obtained after the discussion: Functionality, Flexibility, Auto-Transport, Non-Roundable.

Table 2: Requirements Coming from Six Questions Analysis

WHO	- Immediate Use - Agility - Mobility - Dexterity - Access to the Limited Traffic Area - Flexibility of Use - Accessibility to Closed Spaces - Accessibility to Pedestrian Areas	WHEN	- Reliability - Accessibility - Flexibility of Use - Speed
WHAT	- Transport Capacity for Driver and Other People - Upper Speed of the Pedesions - Dynamicity - Flexibility - Fun - Availability	WHY	- Comfort - Speed - Immediate Use - Fun - Ecology - Autonomy - Dynamicity
WHERE	- Mobility Agility - Access to the Limited Traffic area - Flexibility of Use - Accessibility to Closed Spaces - Accessibility to Pedestrian Areas	HOW	- Functionality - Flexibility - Self Transportability - Not Steal.

The analysis presented above illustrates the twenty-two most important features that the ICTM must possess, which can be listed as follows

1. Use Immediately; 2. Agility, Mobility; 3. Destrezza; 4. Access To The Limited Traffic Zone (A-Ztl); 5. Accessibility To Closed Spaces (Acs) And Pedestrian Areas (Aps); 6. Reliability; 7. Flexibility; 8. Speed In Traffic; 9. Speed; 10. Duration Of Use, Autonomy; 11. Functionality; 12. Non-Rebale; 13. Car Transportable; 14. Capacity Of Transport For The Driver; 15. Transport Capacity For Other Persons; 16. More Fast Of The Pedestrians; 17. Dynamics; 18. Fun; 19. Availability; 20. Comfort; 21. Ecology; 22. Price /Cost.

2.2 Inter-Relationship Matrix

As mentioned earlier, in this work an interrelation matrix is used to evaluate the best urban transport means, based on green and renewable energy, unlike the traditional uses that implement the application in order to estimate the relative importance or the independence relations between the requirements. Moreover, in the present application, the values assigned to each type of means of transport to be evaluated are the following (Table 3) (unlike traditional applications, where the relative importance is evaluated with 0, 1, 2 and the interdependence with 0 1, 3, 9) (Freddi, 2005).

Table 3: Value of Dependency

Value	Evaluation
0	Poor
2	Inadequate
4	Insufficient
6	Sufficient
8	Optimum
10	Excellent

The interrelation matrix is shown below (Table 4); it is used in a new way compared to the traditionally used classic ones, as mentioned before. Starting from the 22 requirements obtained in paragraph 3.1, in the interrelation matrix they were connected to the nine possible types of urban transport means, namely the following:

(1) on foot, (2) cars, (3) motorcycles, (4) scooters, (5) bicycle, (6) scooter, (7) hoverboard, (8) buses and (9) taxis, emerged from a survey conducted by a sample of medium-sized city citizens.

Table 4: Analysis of the Best Innovative Renewable Energy

		ON FOOT	AUTOMOBILE	MOTO	SCOOTER	BICYCLE	PUSH SCOOTER	HOVERBOARD	BUS	TAXI
1	Immediate of Use	10	2	4	6	8	10	10	2	2
2	Agility	10	2	4	6	8	8	10	2	2
	Destrezza	10	2	4	6	8	10	10	2	2
4	Mobility, Accessibility ZTL	10	4	6	8	10	10	10	10	10
5	Ductility of Use, Accessibility Closed Spaces, Pedonability	10	0	0	0	4	10	10	2	2
6	Reliability of Use	10	8	8	6	8	10	8	2	6
7	Flexibility	10	2	4	6	8	10	10	2	2
8	Speed in Traffic	2	2	4	6	10	6	8	2	2
9	Speed	0	10	10	8	6	2	4	6	8
10	Duration, Autonomy	8	10	10	10	10	10	4	10	10
11	Functionality	10	8	8	8	8	6	8	6	6
12	Non-Rubability	10	8	4	4	2	10	10	10	10
13	Auto-	10	0	0	0	4	10	10	6	6

	Transportability									
14	Conductive Transport Capacity	10	10	8	8	8	8	8	10	10
15	Capacity of Transport Persons	4	10	6	6	2	0	0	10	10
16	Higher Speed at the Pedestrians	0	10	10	10	8	4	6	8	10
17	Dynamicity	8	4	6	8	10	10	10	8	6
18	Fun	8	6	8	8	8	6	8	0	0
19	Availability	10	6	4	4	6	10	10	4	4
20	Comfort	4	10	6	8	6	2	4	2	6
21	Ecology	10	2	2	4	10	10	10	4	2
22	Price / Cost	10	0	2	4	6	10	10	4	2

From the aforementioned analysis, it can be noted that, among the nine types of public transport means considered (foot, cars, motorcycles, scooters, bicycles, scooters, hoverboards, buses and taxis), the evaluation conducted among the students of the University of Bologna takes us back to the following considerations:

- Four vehicles are not suitable enough for transportation in the city: cars, motorbikes, buses and taxis have not reached a sufficient mark to be considered as competitive means, in particular: car 5.3; motorbike 5.4; buses 5.1; taxi 5.4. To achieve these results, the parameters related to mobility, immediate use, flexibility, price and the same way were taken into consideration.
- Five vehicles are suitable for transport in the city, but only four (excluding scooters, rated 6.1) can be considered very good (rating above 7): on foot, by bike, scooter and hoverboard. Only the hoverboard is excellent (over 8).

Thus, we can conclude that through an advanced QFD analysis, the hoverboard has been identified as the best type of city transport. For this reason, our works will continue to analyze the hoverboards produced by the main competitors to intercept the innovation objectives in this sector (Sadok Cherif, Aouni and Chabchoub, 2010).

3. BENCHMARKING

Referring to what explained in the previous paragraph, in this phase of work, called Benchmarking Analysis, we can outline.

- How many parameters are considered for the analysis of competitors
- How many parameters are considered for innovation
- Which parameters are measurable performances
- Which performances are considered top (the best ones)
- What performances are considered flop (the worst ones)
- Calculate the top-flop difference for each type of hoverboard
- Intercept the most innovative hoverboard model
- Define the specifications of the innovation targets for the new innovative hoverboard to be designed

The results of Benchmarking Analysis are so strategic, not only to understand what are the hoverboards already present on the market, but above all to understand what is necessary and obligatory to do to get an innovative product that

could be successful in the sale.

Ten hoverboards were analyzed and sixteen technical and economic features were found for each; the identification names of them have been changed for obvious commercial reasons. So, they are identified with the invented codes that we can find in the analysis below.

So, we can summarize all the requests listed above in the table below (table 5).

Table 5: Benchmarking Analysis

PERFORMANCES											VALORI INNOVATIVI PER IL NUOVO HOVERBOARD
Speed (km / h)	13	13	13	16	13	13	16	10	16	24	>24
Battery life (min)	90	90	90	120	60	82,5	60	360	90	30	>360
Charging time (h)	1,5	1	1	2	1,5	1,5	3,5	2	1,5	3	<1
Maximum weight of the driver (kg)	100	100	100	100	100	100	100	100	120	100	>120
Hoverboard weight (kg)	12,2	10	10	14	10	10	17	12	13	11,4	<10
Length (mm)	230	100	100	100	100	100	260	251	203	448	<100
Width (mm)	620	584	584	584	584	584	544	615	600	182	<182
Height (mm)	220	180	180	180	180	180	864	213	198	419	<180
Maximum power (Watt)	350	600	1200	800	1200	1200	1600	1200	700	1900	>1900
Number of engines	2	2	2	2	2	2	2	2	2	1	>1
LED lighting (yes/no)	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Display (yes/no)	SI	SI	nd	No	SI	No	SI	nd	SI	nd	SI
Grades uphill (*)	nd	30°	30°	18°	30°	30°	nd	nd	nd	nd	>30°
Bluetooth for music (yes / no)	No	SI	No	No	SI	No	SI	No	No	No	SI
Other driving modes (yes / no)	nd	SI	nd	nd	nd	nd	nd	nd	nd	nd	SI
	330,5	426,2	378,8	662,93	426,2	331,5	755,83	331,5	473,6	567,35	<330,5

3.1 Results of the Benchmarking Analysis

Ten hoverboard models have been taken into consideration; sixteen main characterizing performances have been linked to each. The hoverboards have been named with imaginative names, in order not to violate commercial problems. The services indicated are the usual ones that we can find on the sales brochures, both on the internet and on flyers. The performances that characterize the hoverboard are (Renzi C. and Leali, 2016).

- Speed (km/ h)
- Battery life (min)
- Charging time (h)
- Maximum driver weight (kg)
- Hoverboard weight (kg)
- Length (mm)
- Width (mm)
- Height (mm)
- Maximum power (Watt)
- Number of engines
- LED lighting (YES / NO)
- Display (YES / NO)

- Climb Degrees (°)
- Bluetooth for music (YES / NO)
- Other driving modes (YES / NO)
- Price (€)

Some of them are measurable with a number and a unit of measure (indicated in brackets), others are evaluated with "YES / NO".

All the performances (or requirements) are listed in a matrix (table 5), to be connected to each model of Hoverboard analyzed. For each line, referring to all the values of the same performance for all types of hoverboards, we will highlight the best requirements in green, and the worst in red.

The value in green becomes the target for innovation for a new hoverboard compared to that specific performance. All innovative goals will be included in one column, to the right of our matrix, entitled "Innovative Values for the New Hoverboard". In this column we can find all the best possible performance for a hoverboard, referring to what we have on the market. However, it would be thinking utopia to create a new hoverboard that reaches all sixteen goals, for many reasons: costs, time, technology, etc. Therefore, further analysis is needed that reveals how many goals are needed to be achieved to achieve innovation.

4. TOP-FLOP ANALYSIS

TOP-FLOP analysis [6,7,8] is a method to achieve innovation with minimum effort (Meuli and Raghunath, 1997). In fact, this method counts the difference between the number of best performances (called "TOP") and the worst number of performances (called "FLOP") for each hoverboard; the value obtained after the difference between TOP and FLOP is the limit to be overcome in order to achieve innovation. Obviously, this value must be the highest value among all ten obtained for each hoverboard model. In our case study, we can see that the limit for innovation in hoverboard is 7, which means that to achieve a new hoverboard, at least "seven plus one" the performance must exceed the relative values in the column "Innovation Goals for the new hoverboard". In our case, to get a new innovative hoverboard, we should improve at least 8 performances. Which 8 performances among the sixteen listed? We will try to answer the question, applying the TRIZ method, which is usually able to suggest the right architecture of a new innovative product.

Table 6: TOP-FLOP Analysis

PERFORMANCES											VALORI INNOVATIVI PER IL NUOVO HOVERBOARD
Speed (km / h)	13	13	13	16	13	13	16	10	16	24	>24
Battery life (min)	90	90	90	120	60	82,5	60	360	90	30	>360
Charging time (h)	1,5	1	1	2	1,5	1,5	3,5	2	1,5	3	<1
Maximum weight of the	100	100	100	100	100	100	100	100	120	100	>120
Driver (kg)	12,2	10	10	14	10	10	17	12	13	11,4	<10
Hoverboard weight (kg)	230	100	100	100	100	100	260	251	203	448	<100
Length (mm)	620	584	584	584	584	584	544	615	600	182	<182
Width (mm)	220	180	180	180	180	180	864	213	198	419	<180
Height (mm)	350	600	1200	800	1200	1200	1600	1200	700	1900	>1900
Maximum power (Watt)	2	2	2	2	2	2	2	2	2	1	>1
Number of engines	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
LED lighting (yes/no)	SI	SI	nd	No	SI	No	SI	nd	SI	nd	SI
Display (yes/no)	nd	30°	30°	18°	30°	30°	nd	nd	nd	nd	>30°
Grades uphill (°)	No	SI	No	No	SI	No	SI	No	No	No	SI
Bluetooth for music (yes / no)	nd	SI	nd	nd	nd	nd	nd	nd	nd	nd	SI
Other driving modes (yes / no)	330,5	426,2	378,8	662,93	426,2	331,5	755,83	331,5	473,6	567,35	<330,5
TOP	3	4	5	3	7	5	3	4	3	5	
FLOP	5	2	3	5	2	4	5	2	2	4	
DELTA O	-2	7	3	-2	5	1	-2	-2	1	1	>7

4.1. Results

Innovative design methodologies have been applied to define both a specific optimized technique and to manage the transition from the conceptual project to the construction project of an innovative means of urban transport, identifying a "list of innovation objectives" through a marking analysis of the benches (BMA). BMA was authorized to apply TOP-FLOP analysis to define the limit of how many requirements are needed to achieve innovation. [9, 10, 11].

5. ANALYSIS OF STYLISTIC TRENDS (FOR THE REDESIGN OF INNOVATIVE CUTTING-EDGE HOVERBOARDS)

At this point, the paper will deal with defining the concept of stylistic "tendency" and subsequently identifying some strands particularly present in recent years that can be aesthetically adapted to the innovative hoverboard model, projecting it into a commercial scenario.

Being an extremely complex subject, this chapter will be introduced with a quote from the book "Design trendsetting. Understanding trends to create successful products ", by Jacopo Filippo Bargellini.

"Today the English word trend, trend in Italian, is very fashionable, and, it would say, very trendy. But what exactly is a trend? To adhere to a vocabulary definition, the tendency is the "disposition of a thing to change in a given way", or, "the direction in which a given phenomenon evolves". There are therefore "trend lines", that is, an uncertain trajectory that characterizes this or that trend. But what is this trajectory? And how long does it last? In a very interesting book entitled "the black swan" the author, Nassim Nicholas Taleb, talks about a turkey and the tendency from his point of view: every day someone feeds him, he is very well and always gets fat more. The trend therefore seems favorable, and the "trend line" grows in a positive sense. Until Thanksgiving, where the trend stops abruptly and the turkey ends in the oven.

So, how can we identify a trend, establish evolutionary lines and above all define lasting hypotheses? If things have always gone in a certain way, as turkey teaches, it is not said that they continue to go that way! On the other hand, things have gone that way for a period of time, and this is a key consideration for a consultant who needs to help a company enter successful products on the market.

If for this company, we are able to identify a trend, to understand its typology and duration, to have it translated into an innovative product and to take advantage of the relative market window, even if very short, the company itself can certainly aspire to prominent positions on the market, without being caught unprepared when the trend will be decreasing.

But here again, questions come back with uncertain answers: is the trend created or followed? And if you follow, who should you follow? Who is trendy? What things, places, people, cities, situations, locales, do they "trend"? And if instead I want to create the trend, how can I invent it? And even if I knew a certain tendency and its duration perfectly, but I was not able to translate it into a convincing product for the market, what would I need?

Treating trends as a concrete and malleable matter would therefore seem very difficult, if not impossible, and yet the very fact that we are today able to indicate some trends on the market, that we can say that "that goes" and that "that does not go", the very fact that there are companies at the top that are trendy, guarantees that it is certainly possible to organize the material, catalog it, tame it, make it docile, subjugate it to our needs and our wishes, and finally exploit it to succeed on the market."

Understanding what a specific trend is, in fact, is difficult, even if, paradoxically, one can easily recognize,

distinguish and define all the characteristics simply by leafing through fashion or furniture magazines, walking in the city or just listening to the latest musical hits.

Having made these first small considerations, it is now clear how the research has been structured, in order to identify a design brief for each of the stylistic trends identified, adaptable to the innovative hoverboard model.

- A **first part**, in which we define what a trend is and how it is formed from the psychological and social point of view, who influencers and a hint of how technology influences trends (with reference to trendsetters). A small paragraph is dedicated to an analysis of behavior of the typical consumer.
- The **second part**, in which we define three stylistic strands, the context and the social-psychological component; the analysis methodologies are then followed, accompanied by moodboards of inspiration to favor the study of the forms.
- The **third part** is dedicated to the organization of its analysis and research structure, to the methods of translating trends into real products, through the indication of scenarios and the definition of the design brief. The study of materials and cost analysis will also be addressed.

5.1. Analysis of the Trend Concept

5.1.1. Tendency from the Social and Psychological Point of View. How is the Trend Formed?

The group serves to confront, to establish relationships, to create new ideas from the union and discussion of the ideas of individuals, but also to create fashions and trends. Thanks to the individuals who come together, fashions and styles are transmitted. What is the process that leads to the creation of a fashion? And why do you suddenly want to slip on the flared jeans that we had forgotten on the bottom of the wardrobe while we were wearing prideful cigarette pants? Nothing is left to chance, fashion is "one of the typical forms of collective behavior". Why does the human brain sometimes follow its own path and sometimes conforms to the ideas of the most original?

It would not be a fact related to the stimulus to resemble others and not even a prerequisite related to the insecurity of the individual in the group, but rather a way to be just, in order not to be mistaken for behavior, attitude, clothing and sometimes even a friend.

The research comes directly from the cognitive science studies center F.C. Donders to Caltannissetta, who transmitted the results of the brain test done to study how each person's brain makes unconventional choices and how it adapts to the surrounding reality.

The volunteers were asked questions and while the judgment phase was taking place, only certain areas of the brain were activated in the volunteers, including that of learning and positive reinforcement.

Here then, is the answer to the initial question: how is the trend formed? If the group likes a choice, the brain will remember that the choice was a social pass and will do it again. If the group does not like the choice, the single, unless it is deliberately the classic "bastian contrary", will redo it.

Imitating others and conforming, then, is a fact linked to social learning, a completely normal process, not conditioned by rational thought, but rather a reaction of the unconscious in front of the situations that arise in daily choices.

Learning that an action is good for everyone, that is good for oneself, that puts in good light, that benefits or leads

to a result, will be a good reason to do it again, and here is the trend is written. What instead of society is not good, does not like, does not pass in the group, then it will not be redone.

5.1.2. What is a Trend from a Stylistic Point of View?

The trend is a creative hypothesis. Nothing consolidated or tangible. It's something you can work on and give shape to. Born of wishes and needs; it is something that is not given to which body is given.

5.1.3. Who Creates the Trend?

At the base of the creation of a trend, there are individuals who wear particular accessories, make new combinations, choose unusual colors. These individuals are called influencers. To be an influencer is not enough to wake up in the morning and dress in a strange way. Behind a certain realization there must be an idea, a project, the translation of a broader concept.

The influencer is such because, he is able to provoke a reaction in the people around him, even negative. It is not a person that goes unnoticed. He is a person who causes a reaction between the people with whom he interacts. People who first react to this innovation are called early adopters, early users who first take a novelty. The initial trend then comes to the so-called opinion leaders, trendsetters or festivals. In this way the range of the initial signal is enlarged.

It is a process that starts from the bottom and is then reinterpreted. In most cases, these initial signals, when they become a real fashion, are no longer even recognizable with respect to the origin.

At the end, there are the late adopter: who said that he would never wear something and maybe he does it when that fashion is about to end. Like those who have always refused to wear low-waisted pants, so to speak, and in the end they did. This is the life curve of the training and end of a fashion process. It is a cyclic process in different stages, from the origin to the shelves of large retailers

5.1.4. New Technologies that Influence Trends

New technologies, especially social media, have created real "monsters". There are people who are followed (followed) by millions of other individuals, so, for pure pleasure.

The companies have obviously adapted and tend to bomb the millions of highly influential followers day and night of advertisements, mostly masked-like.

So, why not exploit these trendsetters (basically, people who have the ability to be heard by others and who therefore have a strong influence on their "public") in the communication and marketing fields?

It is essential to identify the right person for the product you want to promote; for example, taking as reference Chiara Ferragni, perhaps the most famous blogger at the time, would be perfect if the product you want to sell is destined for a public with a clear predominance of women and between the ages of 13 and 45. So, you have to study their audience and the followers, who have accumulated on various social networks, only then evaluate if it is the right person.

The concept that was wanted to underline these considerations on the concept of trend is this: research trends are not limited to guess the shade of red that will fall next autumn or to predict the fate of a material that until the year before has made record of purchases. Research trends can be a useful tool for all (or many) to know the past, understand the present, plan the future.

5.1.5. Consumer Behavior

Before proceeding to the choice of trendy stylistic trends on which to do research, a paragraph will be dedicated to the study of the behavior of the typical consumer, in order to understand what drives us to buy the products we buy, to create a 360-degree vision.

There are external and internal factors that determine our consumer behavior. External factors imply accessibility, availability and economic convenience (what products are available, if we can afford them, and so on).

Internal factors are related to motivations, preferences and personal needs, determined in turn by different influences. Commercial communication is one of these influences, but it is not the only one. Most of our consumption is determined by the behavior of those around us. Recent studies of neurology show that we are much less rational, less disciplined when it comes to shopping.

According to some studies, 90% to 95% of the choices we make in the shop are determined by impulse, emotions and habits. We mainly buy what we know. Only a small percentage of our purchases are determined by a conscious decision.

Of course, the results may vary depending on the group. Young people seem to be more influenced by commercial communication.

5.2. Identification of Stylistic Strands

At this point, it is necessary to reiterate what was written in a previous paragraph, that understanding what a specific trend is, can be complex, but to identify and define the characteristics it is sufficient to look around: to notice what kind of product they offer us, whether clothing stores, dealerships, TV commercials or paper brochures, browse fashion or furniture magazines, stroll around the city, visit exhibitions, listen to the latest musical hits... the world adapts to the passing of fashions, so it is essential to keep the open eyes to stay in step with the times.

On the basis of the research carried out, three stylistic strands have been identified as protagonists of the last two years:

- Retrò Style (with particular reference to the 50s)
- Natural Style
- Stone Design

5.2.1. Retro Trend - 1950s

The '50s are the years of the post-war period, when poverty was rampant but where the desire for innovation and above all the desire to free one's creativity was breathed. The '50s are the years when everyone just wants to find a way to recover and move forward towards the future, the years in which the desire for novelty and creativity is reborn. These are the years in which functionality and style become protagonists, together with the industrial production of many tools that until then were unimaginable, such as appliances that in recent years have been improved and started to be mass produced.

When you think about the design of the 1950s, appliances that have changed the face of our kitchens come to mind, subverting the classic role of traditional housewife. Smeg refrigerators are the emblem, with their rounded shapes and pastel colors. The toaster, the Bialettimoka, the Moulinex robot, follow suit: the vacuum cleaner and a whole series of

home appliances ready to lift the woman out of her strenuous domestic work.

Even the furniture obviously changes. It is not just a purely aesthetic change. In fact, the furniture is first produced in series so that they are as cheap as possible and are made in new increasingly functional versions. Functionality is the prerogative especially of new modular and modular furniture such as bookcases and kitchens. In this way it is possible to optimize the spaces in the best possible way and create truly personalized environments. Still in the field of interior design we can not fail to mention the Lady Arflex armchair designed by Marco Zanuso. It is the first modular armchair, made of metal and polyurethane foam with foam padding. The transition from the war to the boom years is evident in the use of foam rubber, which is proposed as a material for furniture.

Also in the field of lighting, certain lamps have marked the design of the 50s, see Pendant Lamp by Aalvar Aalto of clear Nordic inspiration or the floor lamp Azucena Ball of Earth with a spatial flavor.

5.2.2. Why Retro? Analysis from a Social and Psychological Point of View

The charm of nostalgia. We are all, of course, naturally inclined to be curious about the past, and like a good vintage wine, it seems that the tastes of the past find new vigor with the oxygen of the present: the contemporary historical context, made of crisis, saving and recovery, has certainly accentuated this miraculous practice of resuscitation of forgotten objects. In fact, not being able to buy, what better solution than dressing up with grandma's clothes, furnishing the house giving new life and painting to wood, or changing a wall with other colors?

Vintage is everywhere and fashion and furniture design are the most affected gills of this return to the past (examples in Figures below, from 1 to 5).



Figure 1 - 5

5.2.2. Natural Trend

Over the years, furnishing trends confirm the direction towards a natural style.

The discreet design is important for the modern concept, thanks to which the natural furnishings never take on a rustic look. Trendy colors heat the room and emphasize the furniture. In fact, nature has always been a source of inspiration for painters, artists and architects, and the latest trends in interior design are no exception: plants, forests and animals become an integral part of a home's interior design.

The furniture in which the veins and the structure of the wood are visible, which accentuate the natural design of the new furnishing trend. Furthermore, the warm tones of the wood give the environment a certain charm. A high-quality

workmanship of the furniture is however a decisive element of the new trend, which therefore does not contemplate the use of wooden furniture with rustic or rough surfaces.

The same applies to fabrics: linen, wool and cotton in the most diverse processes are adapted to the natural design furniture: the current trend returns yes to tradition, but interprets it in a modern and innovative way.

Even the lighting, especially the LED, is the protagonist: the energy-saving LED lights not only have a longer life than traditional light bulbs, but are also in demand in modern homes thanks to their multiple uses. Although they have been used for a long time both in electrical equipment and for decorative purposes, LEDs often did not find use in home lighting because their "hard" light could be too intense. Now, however, LEDs with warm colors are also available, making them perfect for the new housing trend. LEDs with the typical light of old light bulbs are particularly popular.

To underline the lightness of the furniture, the current trend recommends lighting the house using pastel colors. These colors highlight especially the light wood. Walls, decorative objects and fabrics of these colors are decisive for giving the house a convincing natural look.

Home accessories can have original geometric shapes, for example textiles printed with triangular patterns, or hexagonal boxes and clocks. Playing with the balance geometry with a touch of creativity is the natural design of the house.

Accessories for your home can have originals geometric shapes. There are, for example, textiles printed with triangular motifs, or hexagonal boxes and clocks. Absolutely captivating are vases, lampshades and bowls covered with a modern pleating technique. Playing with the balance geometry with a touch of creativity is the natural design of the house.

5.2.2.1. Why Natural? Analysis from a Social and Psychological Point of View

When one chooses to think of the house as a space for the mind, one must adopt the style of lightness. It is first of all a philosophy of life, which chooses the elegance inherent in composure.

If the intent is to let nature into the home, it is certainly not necessary to plant a tree in the middle of the living room, even if there are those who can do this too, a table can be enough with a natural print that brings the mind back to the smell and the feeling of the forest.

Finally, it must be remembered that a decor inspired by nature is not only beautiful to see but also good for the spirit, naturalistic intelligence is the eighth manifestation of human intelligence, defined as the ability to enter into deep connection with beings non-human living and to appreciate the effect that this relationship has on us and on the external environment (Figures 6-8).



Figure 6 – 8: Examples of Natural Style Products

5.2.3. Stone Design Trend

In order to analyze the latest stylistic trend, the automotive field is broadened; full of novelties and fashions, provides guidelines for the study of shapes.

Compact, mini, crossover, full size: the automotive market for several seasons is literally invaded by a sea magnum of Sport Utility Vehicle models of all kinds, style, size and price range.

In consideration of new groups of buyers made up of Russians and Asians, who are currently among the most moneyed in the Planet, several of the most prestigious car manufacturers are focusing decisively on luxury sports vehicles, designing increasingly exaggerated SUVs.

With regard to this, "Il Sole 24 Ore" writes:

"The reasons for the success of Suv and crossover are well known: a gritty appearance, innovative style and in many cases sporty as well as elegant and elevated driving position. The spread of these is also favored by the proliferation of models, which the manufacturers are converting their production more and more towards the models most liked by buyers.

According to the Dataforce Forecast, which also uses official sources of information from the OEMs, in 2021, 113 different Suv or crossover models will be on sale in Europe. Two years ago there were only 73. The market for other types of bodywork was much less "sparkling". Among the compact, in four years the models will be 44, with a modest increase compared to 36 for sale two years ago. The number of city cars is stable over time (around thirty, as well as for the medium ones). Few cars of the upper class: 12 only in 2015, 14 those scheduled in 2021.

The change in the tastes of customers and the repositioning of the offer has already produced a striking result in the market: the compact (Golf, if we refer to an example) are no longer the best-selling cars on the continent in the business channel, but since 2015 the SUVs and crossovers have become so. We are not talking, of course, of the individual models (Golf remains the best-selling car in Europe), but of the total body types. The gap that differentiates Suv and compact is destined to widen further from here to the next years: in 2021 every three compacts will sell four Suv / crossover. Suv is the only type of bodywork that will grow in altitude, while all the others remain constant over time (and this has happened for some years).

In concrete terms: the progressive and constant increase of registrations that will be registered in Europe in the next few years will be all merit of Suv and Crossover.

But what will be the types of bodywork that will see sales decrease in the next few years? Surely the Small, that is the city cars, which in the fleets have sailed for a long time at a market share of around 10%. According to Dataforce Forecast, at the end of a four-year period, they will fall to 8%. The middle class cars have long been suffering: they were 15% in 2004, they will be less than half in 2021. This year they will be about 8%. The fall in Medio sales began with the downsizing triggered by the economic crisis, but the final blow was responsible for the spread of SUVs and crossovers of the middle and lower category. Basically, to clarify the concept with an example, European car drivers who use the car for work give up the Audi A4 to get behind the wheel of a Q3. And those who once chose a Lancia Delta, today are very satisfied with their Fiat 500X. "

In addition, there is no lack of publicity, unlike electric cars, that although the propensity to purchase is good and

as many models are available, public incentives are lacking. For example, many new Suv and crossover models, such as the Alfa Romeo Stelvio or the Range Velar, were presented at the Salone del Mobile during the Milan Design Week. In fact, it would be a question of combining the automobile in the furniture sector and not only.

Communication is changing and in addition to the normal presentation of a new car, it is more and more often the case that the image of the brand is perceived.

What better solution would be to get it out of its field to make it lose the stereotype that sees the machine always "dirty, dangerous and polluting in favor of a tool at the forefront of research, but also in design and technology.

5.2.3.1. Why Stone Design? Analysis from a Social and Psychological Point of View

Sport urban vehicle, in recent years has truly become a fashion; all the car manufacturers have equipped themselves and adapted, and almost all of them have an SUV line to meet the new demands of the market.

According to a research by the Milan daily LEGGO, SUVs almost always travel with a single passenger, maximum 2. In practice, rare cases are in which large families buy a very large car in terms of seats and boot to make us all the members of the family. Indeed, recent demographic data on development in Italy tell us that families are increasingly restricted.

And then a question arises spontaneously, why? Why do people buy these sheet metal and steel monsters? They are expensive, require a lot of maintenance, consume a lot, are very difficult to park and have performance in terms of power and space that, almost always do not affect the end user.

Well, SUVs protect us from the dangers of the world: they are a formidable armor against everything we fear and that is dangerous to us. Pollution, reckless driving by other drivers, dirt, crime and even noise. In the last 30 years the research on the pathogenic factors of the cities has increased a lot, so much so that today we have a maximum limit of concentration of fine particles in the air that the European Community allows us to have, increasingly binding speed limits, bumps to reduce speed, a lot of social alarm on delinquency and crime. The news organizations are increasingly giving us news on how polluted, noisy, dirty and dangerous our cities are. This psychological explanation naturally identifies only a part of the problem: in fact, we must not forget that the car is a status symbol, that is, it represents the social and economic status of its owner. The person who guides you feels important and powerful, even more when driving a huge and heavy vehicle.

However, the psychological explanation should not be underestimated: as McLuan had guessed in the 60s, with the advent of television (today, even more with that of the Internet), the private sector suddenly became public. Everything that was previously known by a few experts in the field and that lay forgotten in some drawer, is now available in 3 or 4 formats on the internet. Television speaks of it and we are all more aware of the dangers that surround us.

Our fears have increased, and so we have strengthened the defensive measures by acquiring these great metropolitan armor.

If today, one of us faces the Milanese suburbs with an old Fiat 500 you would feel virtually "naked", without defenses and at the mercy of the dangers that lurk everywhere, a small mouse in the middle of a herd of angry bison.

In practice, mass access to information has produced much more awareness in people, but has also raised many fears.

Think about how our perception of road safety has changed; Today we talk a lot about the rules for accident prevention, the importance of using the headset while driving, not to drink before driving, to fasten the belts.

All this has increased our awareness of the dangers and also reminding our fears.

A motorist of the 60s was certainly more ignorant, but perhaps even more serene in driving. For this reason, he was not afraid to drive a Fiat 500 even for long journeys.

Moreover, according to a news re-launched by the Republic, a New Zealand study has found that the drivers of sport Utility are the most distracted and dangerous, for themselves and for others. The research, conducted in New Zealand on a sample of 1,196 Suv owners and published in the New Scientist magazine, has found that these tend to distract more and that 55% of them drive with one hand on the steering wheel. According to Jared Thomas, head of research, the result could be explained by the fact that "Being inside a vehicle that is bigger and taller than the others makes Suv drivers believe that, it is safer and makes it perceive a reduced level of risk compared to drivers of conventional machines ".The SUV accompanies the sense of domination of the road (Figures 9 and 10).



Figures 9-10: Examples of Stone Design Products

6. SKETCH OF THE NEW PRODUCT ACCORDING TO STYLISTIC TRENDS

6.1. From Sketches to Virtual Models in 3 Rendered Dimensions

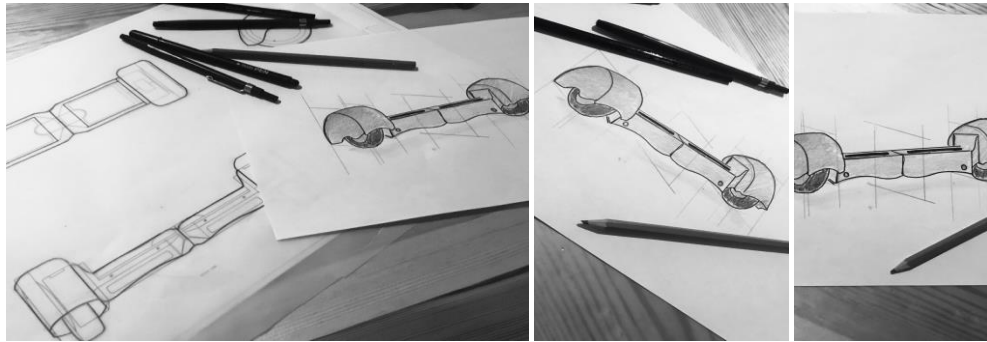
The method (developed in Pininfarina by Ing. Andrea Ramacciotti) intends to order the following phases for arriving to the final styling prototype (Stylistic Maquette).

- Free Hand Sketches: one for each stylistic trend
- Choice of the best sketches aligned to the stylistic trends
- transposition of the sketches into 2d drawings with orthogonal projections
- using 2d orthogonal projections drawing as blueprints to be inserted in CAD Modelling Environment
- CAD 3D Modelling of the best solutions
- 3D Prototyping of the best proposal: Physical Model (3D Printing) or Digital Model (Augmented Reality)

Here below, the method above mentioned is applied to the stylistic development of the innovative overboard.

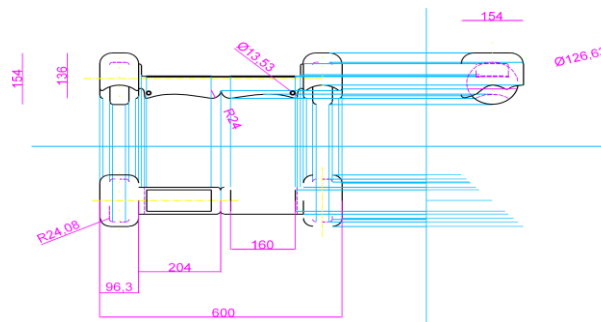
6.1.1. Retrò Style Development of Hoverboard

6.1.1.1. Sketches (Figures 11, 12, 13)



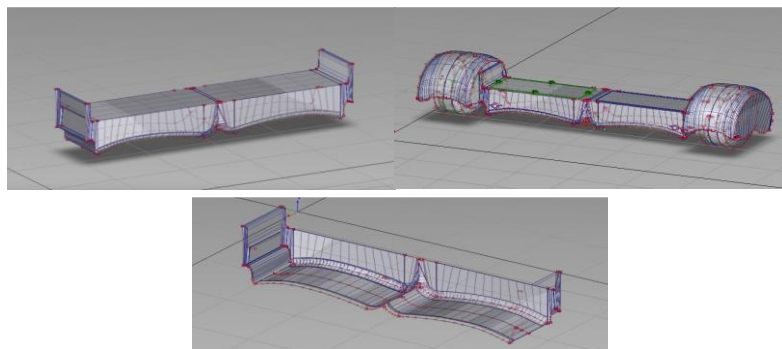
Figures 11, 12, 13: Sketches of Retrò Proposal

6.1.1.2. 2D Drawings (Figure 14)



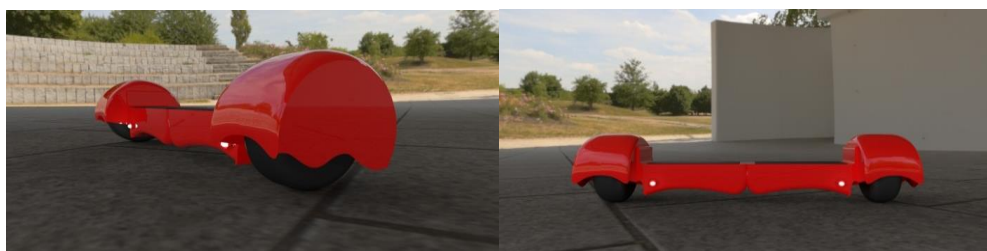
Figures 14: 2D Drawings of Retrò Proposal

6.1.1.3. 3D Model (Figures 15, 16, 17)



Figures 15, 16, 17: 3D Models of Retrò Proposal

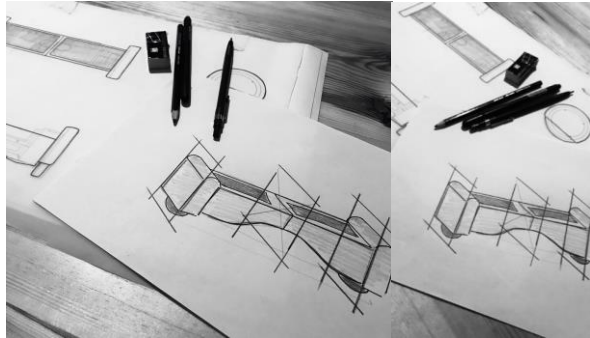
6.1.1.4. Rendering (Figures 18, 19)



Figures 18 and 19: Rendering of Retrò Proposal

6.1.2. Natural Style Development of Hoverboard

6.1.2.1. Sketches (Figures 20, 21)



Figures 20 and 21: Sketches of Natural Style Proposal

6.1.2.2. 2D Drawings (Figure 22)

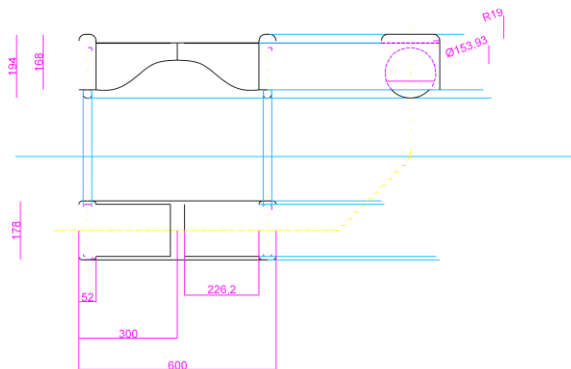
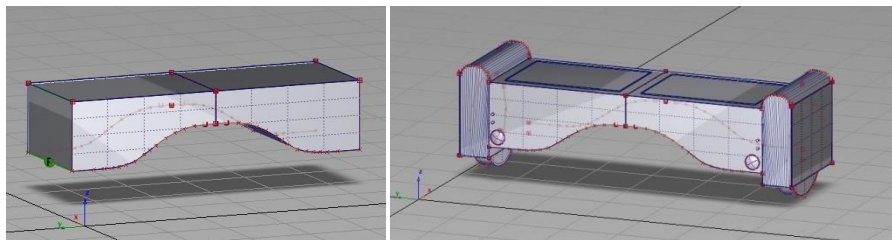


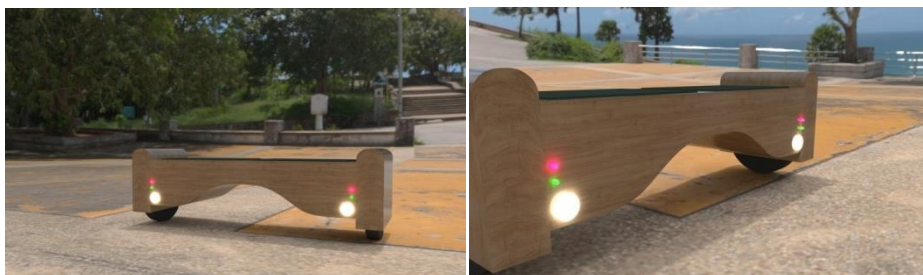
Figure 22: 2D Drawings of Natural Style Proposal

6.1.2.3. 3D Model (Figures 23, 24)



Figures 23 and 24: 3D Model of Natural Style Proposal

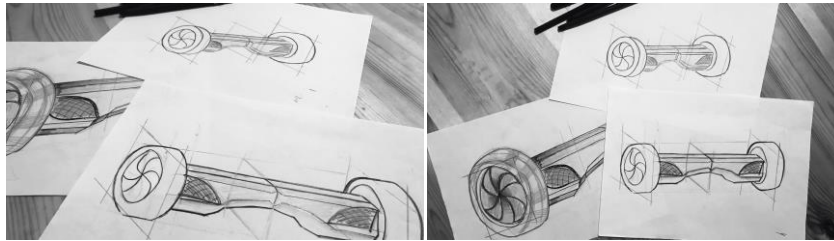
6.1.2.4. Rendering (Figures 25, 26)



Figures 25 and 26: Rendering of Natural Style Proposal

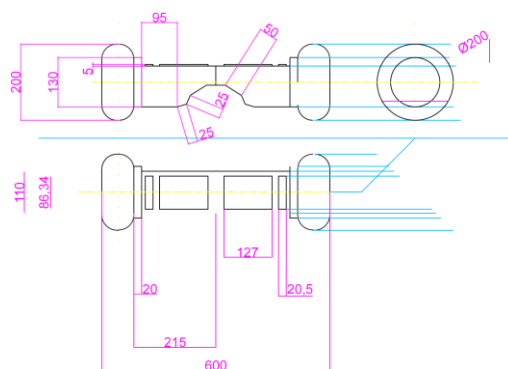
6.1.3. Stone Design Style Development of Hoverboard

6.1.3.1. Sketches (Figures 27, 28)



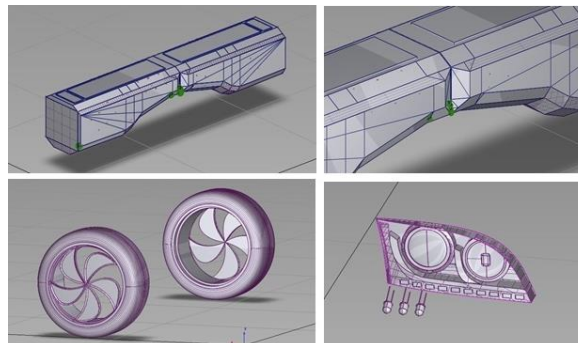
Figures 27 and 28: Sketches of Stone Design Style Proposal

6.1.3.2. 2D Drawings (Figures 28, 29)



Figures 28 and 29: 2D Drawings of Stone Design Style proposal

6.1.3.3. 3D Model(Figures 30, 31, 32, 33)



Figures 30, 31, 32, 33: 3D Model of Stone Design Style Proposal

6.1.3.4. Rendering(Figure 34)



Figure 34: Rendering of Stone Design Style Proposal

7. CONCLUSIONS

The present paper, following the three precedent ones on the same theme (all published on Far East Journal of Electronics and Communications or on JP Journal of Heat and Mass Transfer), intended to describe a styling development about a new green transportation means for urban use, just like an overboard.

Starting from a preliminary analysis, in which it was shown that the future means for moving in urban traffic will probably be light, portable, rechargeable customized vehicles as overboard, and alike are, the work has presented a study about the stylistic procedure adopted in the main design company in Italy.

Here, the styling design method was described. All the phases were developed. Three different kinds of aesthetical configurations were realized.

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